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EP 0589337 A1 US 4403679 A
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(54) Abstract Title
**Machine tool with pressure compensating device**

(57) A machine tool, more particularly a hand-guided hammer drill, with a lubricant chamber 10, in which at least one rotatably driven component 12 is arranged, and having a pressure compensating device 16, comprises at least one rotatably driven centrifugal component, where the centrifugal component is formed by a filter element 20. The filter element may be an annular component made from felt. A pressure compensating duct 36 may also be provided.

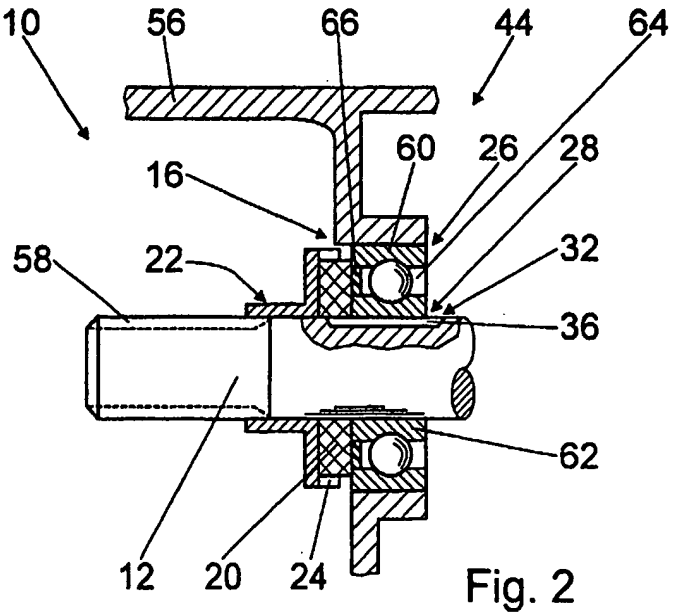


Fig. 2

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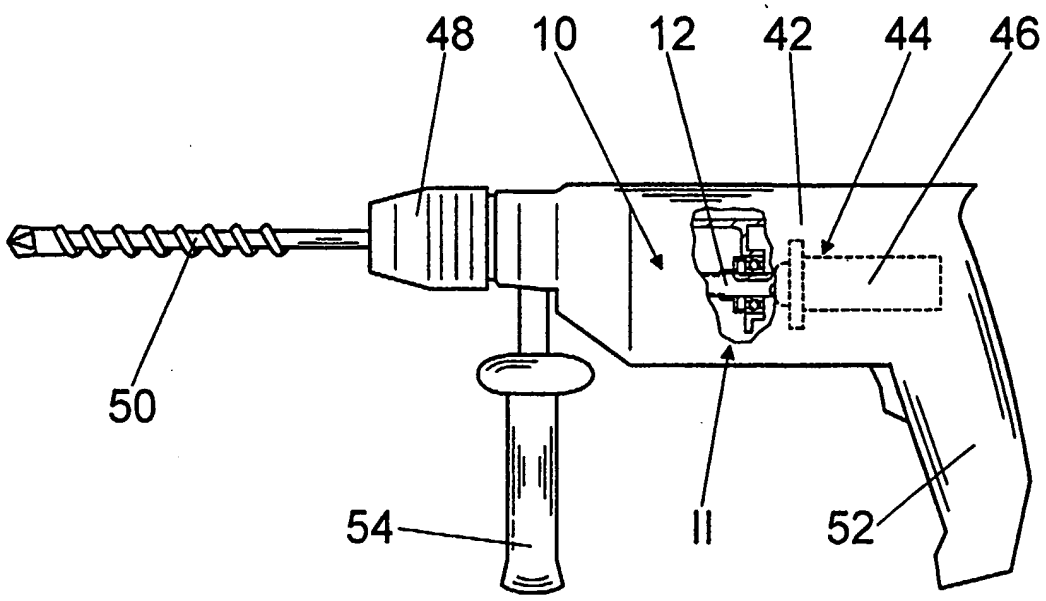


Fig. 1

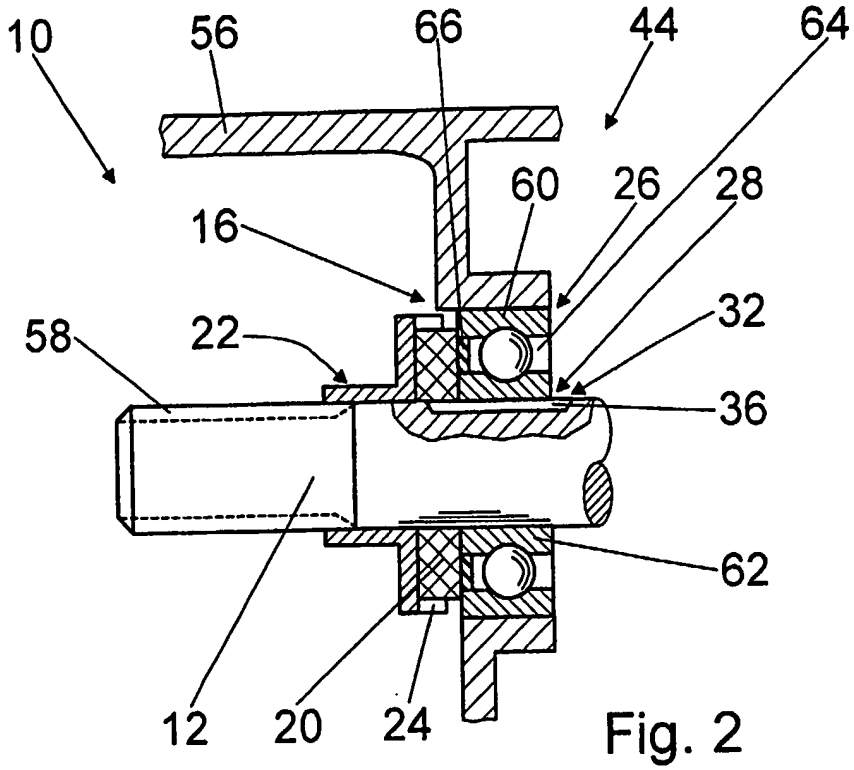


Fig. 2

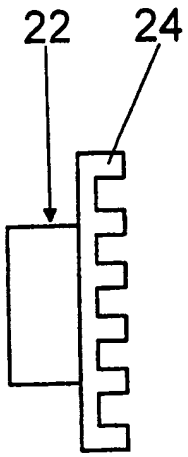


Fig. 3

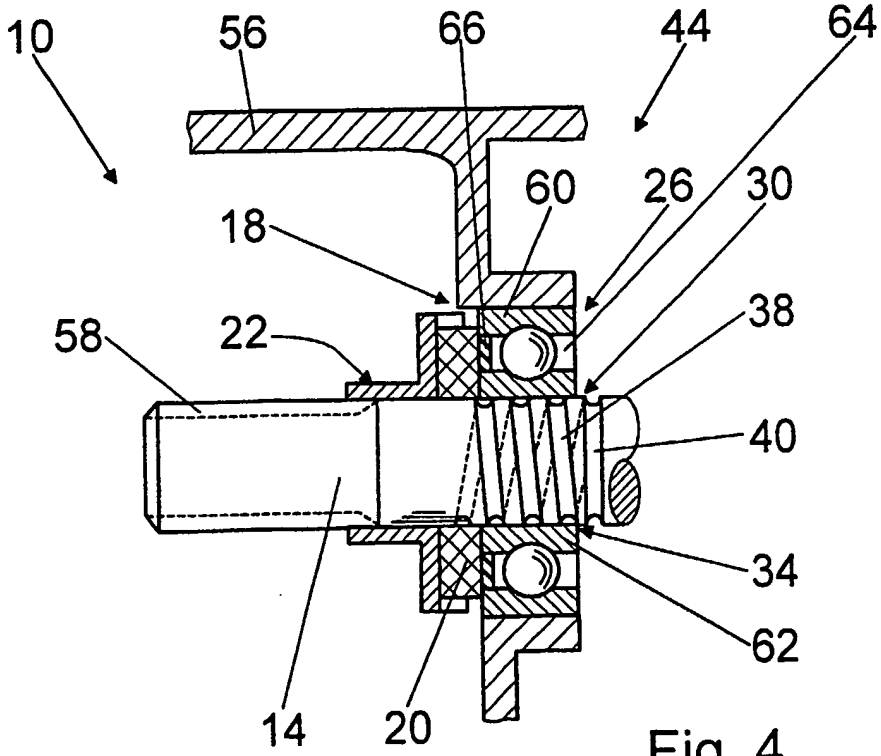


Fig. 4

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# A machine tool with a chamber with lubricant and a pressure compensating device of the chamber

## State of the Art

The invention proceeds from a machine tool with a chamber with lubricant and a pressure compensating device of the chamber according to the preamble of claim 1.

A machine tool of the generic type, more particularly a hand-guided hammer drill, is known from DE 42 31 987.0 A1. The hammer drill comprises a drive motor arranged in a motor chamber of a housing with a motor shaft, which extends through a housing section into a gearing chamber where it engages via a moulded-on pinion with a gear of a gearing for driving a tool carrier. The gearing chamber is provided with a pressure compensating device, which discharges a pressure forming in the gearing chamber during operation towards the atmosphere or towards the motor chamber. The pressure compensating device comprises a pressure compensating duct, which leads from the gearing chamber to the outside or to the motor chamber, is constructed as a bore and is formed in a housing section.

The pressure compensating duct is screened by a rotary element or centrifugal component, which is rotatably mounted in the gearing chamber on a journal moulded onto the housing section. The rotary element is formed by a cup-shaped sheet metal part, in which an opening is formed. The rotary element is operatively connected to the gear of the gearing driven via the pinion and is more particularly connected to the said gear via a compression spring, whose

ends act in a positive-locking manner upon the gear on the one hand and the rotary element on the other hand. The compression spring transmits the rotary movement of the gear to the rotary element.

Advantages of the invention

The invention proceeds from a machine tool, more particularly a hand-guided hammer drill, with a chamber with lubricant, in which at least one rotatably driven component is arranged, and with a pressure compensating device of the chamber, which comprises at least one rotatably driven centrifugal component.

It is proposed that the centrifugal component is formed by a filter element. By means of the filter element, air and lubricant can be advantageously separated and as a result of a centrifugal force acting upon the filter element during operation, an advantageous self-cleaning of the filter element can be attained at all times. By means of the filter element, it is possible to achieve an advantageous ventilating function and sealing function over a long service life. The solution according to the invention is particularly suitable for highly fluid lubricants and can therefore be particularly advantageously used in oil-lubricated hammer drills, for example. However, use with more viscous lubricants is also appropriate in principle.

Particularly in the case of hand machine tools, a motor shaft often has a much higher rotational speed than the gearing shafts which are present. If the rotatably driven component is formed by a rapidly rotating motor shaft of this type, for example by a motor shaft of a hammer drill and/or hammer chisel, particularly high centrifugal forces can be advantageously used for self-cleaning. However, it is also conceivable in principle

for the filter element to be arranged on a gearing shaft.

The centrifugal component may have various forms which appear practical to the person skilled in the art and may be directly or indirectly connected to a shaft. For example, the centrifugal component may be formed by individual square elements, which are distributed over a circumference and are held in a special holding device non-rotatably arranged on a shaft. However, the centrifugal component is particularly advantageously formed by an annular component. An annular surface can be sealed in a structurally simple manner using a component of this type. Furthermore, the centrifugal component can be simply arranged directly on a shaft and additional components, structural space, assembly outlay and weight can be saved.

In a further development of the invention, it is proposed that the annular centrifugal component is non-rotatably held on the rotatably driven component by an annular holding component with individual holding elements extending in an axial direction. Secure holding of the centrifugal component can be attained and undesirable deformation of the centrifugal component as a result of the centrifugal forces can be prevented by means of the individual holding elements, whilst a large usable and uncovered filter volume is nevertheless obtained as compared with the overall volume.

Particularly suitable as a centrifugal component or as a filter element is a felt seal, which can be manufactured in a particularly cost-effective manner and has advantageous, proven properties. The felt element can be formed by various fibrous materials which appear practical to the
person skilled in the art, such as, more particularly, animal hair, vegetable fibres and/or synthetic fibres,

etc.

If the centrifugal component is arranged directly upstream of a bearing of the rotatably driven component in the direction of ventilation of the chamber, then the centrifugal component can be additionally used for sealing the bearing and additional components can be dispensed with. Furthermore, the bearing in particular can be advantageously used in order to form at least one section of a lubricant seal of the pressure compensating device, by means of which a pressure in the chamber can be compensated. Additional components, structural space, weight, assembly outlay and costs can be saved. This can be attained in a structurally particularly simple and cost-effective manner by means of a lubricant seal which is constructed as a gap seal arranged between the bearing and a bearing seat, it being possible to arrange the gap seal between an outer ring and/or between an inner ring of the bearing and a bearing seat. Furthermore, it is conceivable for the lubricant seal, which can be simultaneously used for pressure compensation, to be formed by a duct through the bearing, for example by a duct through a cage of a roller bearing and/or by bearing sealing disks appropriately secured to the bearing.

In a further development of the invention, it is proposed that a pressure compensating duct is formed in a bearing surface of the bearing and/or in a bearing surface of the bearing seat. An advantageous cross section for pressure compensation can be obtained in a structurally simple manner, whilst at the same time realising a gap seal and/or labyrinth seal. In this respect, the pressure compensating duct can be constructed, for example, in the form of an axial groove in a shaft, in an inner ring of a roller
bearing, an outer ring of a roller bearing and/or in a component forming an outer bearing seat.

If the pressure compensating duct is at least partially formed by a thread-shaped recess, an advantageous labyrinth effect or labyrinth seal can be attained and in addition a return conveying effect can be obtained, namely by suitably coordinating the thread direction and direction of rotation. The thread-shaped recess can again be formed in the bearing and/or in a bearing seat. If the pressure compensating duct opens out into at least one annular groove, then this can be manufactured in a particularly simple and cost-effective manner, for example in a turning process, starting with a first annular groove and opening into a second annular groove.

The solution according to the invention can be used in all machine tools which appear practical to the person skilled in the art, in particular in hand machine tools, such as grinding machines, saws, milling tools, planes, drilling machines, hammer chisels, etc.

Drawings

Further advantages will be clear from the following description of the drawings. In the drawings, embodiments of the invention are illustrated. The drawings, description and claims contain numerous features in combination. The person skilled in the art will also expediently consider the features individually and bring these together in further practical combinations.

In the drawings:

Fig. 1 is a schematic side view of a hammer drill,

Fig. 2 is a fragmentary view from Fig. 1 characterised by the reference II,

Fig. 3 shows a holding component from Fig. 2, and

Fig. 4 shows a variant of Fig. 2 with a thread-shaped pressure compensating duct.

Description of the embodiments

Fig. 1 is a schematic view of a hammer drill with a housing 42, in which a drive motor 46 is mounted in a motor chamber 44. By means of the drive motor 46, a tool holder 48 and a drill 50 secured in the tool holder 48 can be driven so as to rotate and strike via a gearing, not shown in further detail, arranged in a gearing chamber 10. Disposed in the gearing chamber 10 is a lubricant for lubricating the gearing. The hammer drill can be guided by means of two handles 52, 54 extending substantially perpendicular to an operating direction, one handle 52 being moulded onto the housing 42 on a side remote from the drill 50, and one handle 54 being secured to the housing 42 on a side facing the drill 50.

The drive motor 46 comprises a drive shaft 12, which projects from the motor chamber 44 through an intermediate wall 56 made of aluminium into the gearing chamber 10 and is rotatably mounted in the intermediate wall 56 in a ball bearing 26 (Fig. 2). The ball bearing 26 is arranged with its outer ring 60 via a press seat in a non-rotatable manner in a bearing seat formed by the intermediate wall 56 and is arranged with its inner ring 62 via a press seat in a non-rotatable manner on a bearing seat 32 formed by the drive shaft 12. A bearing gap 64 between the outer ring 60 and the inner ring 62 is covered by means of a ring 66. A pinion 58 is moulded onto an end of the drive shaft 12 projecting into the gearing chamber 10, by means of which pinion the drive shaft 12 can mesh with a gear arranged in

non-rotatable fashion on an intermediate shaft of the gearing, not shown in further detail.

A pressure compensating device 16 of the gearing chamber 10 comprises a centrifugal component formed by a filter element 20. The filter element 20 is formed by a felt ring and is arranged in a non-rotatable manner on the drive shaft 12 of the drive motor 46 directly in front of the ball bearing 26 in the ventilating direction of the gearing chamber 10. The filter element 20 is held in non-rotatable fashion on the drive shaft 12 by an annular holding component 22 with individual holding elements 24 extending in the axial direction (Figs. 2 and 3). The holding component 22 is non-rotatably connected to the drive shaft 12 via a press seat.

The filter element 20 prevents lubricant from escaping from the gearing chamber 10 at the ball bearing 26 in the direction of the motor chamber 44 and also allows for pressure compensation. A pressure build-up in the gearing chamber 10 as a result of heating during operation of the hammer drill can be reliably prevented. The filter element 20 is pressed against the outer ring 60 and against the inner ring 62 of the ball bearing 26 and seals a bearing gap between the outer ring 60 and the inner ring 62 of the ball bearing 26 in the direction of the motor chamber 44 in a lubricant-tight manner. When the hammer drill is operated, the lubricant partially absorbed by the filter element 20 is conveyed by a centrifugal force acting upon the filter element 20 out of the filter element 20, through recesses between the holding elements 24 back into the gearing chamber. The filter element 20 is cleaned, so that an advantageous pressure compensation is ensured at all times by means of the said filter element 20.

Furthermore, the ball bearing 26 of the drive shaft 12 forms part of a lubricant seal 28 of the pressure compensating device 16, by means of which a pressure in the gearing chamber 10 can be compensated. More particularly, a pressure compensating duct 36 is formed in a bearing surface of the bearing seat 32 formed by the drive shaft 12. The pressure compensating duct 36 is formed by a groove, which extends axially in both directions over the inner ring 62 of the ball bearing 26. Over its extension, the inner ring 62 of the ball bearing 26 forms the radial outer boundary of the pressure compensating duct 36. Instead of a pressure compensating duct, it would also be conceivable, for example, to arrange the ball bearing 26 with its inner ring 62 in non-rotatable fashion with a slide seat on the drive shaft 12 and for a pressure compensation to be realised by means of a gap seal between the drive shaft 12 and the inner ring 62.

Fig. 4 shows a variant of Fig. 2 with a pressure compensating device 18. Components which remain essentially the same are essentially indicated by the same reference numerals. Furthermore, reference can be made to the description of the embodiment in Figs. 1 to 3 in respect of features and functions which remain the same. The following description is essentially restricted to the differences as compared with the embodiment in Figs. 1 to 3.

Instead of an axial groove, a pressure compensating duct 38 formed by a thread-shaped recess is formed in a drive shaft 14 of a drive motor in a bearing surface of a bearing seat 34 formed by the drive shaft 14. The pressure compensating duct 38 extends in the axial direction over an inner ring 62 of a ball bearing 26 of the drive shaft 14 and opens out into an annular groove

40 in a motor chamber 44. Together with the inner ring 62 of the ball bearing 26, the pressure compensating duct 38 forms a lubricant seal 30, more particularly a labyrinth seal, and also has a return conveying action of the lubricant into the gearing chamber 10 during operation.

Reference numerals

| | |
|---|---|
| 10 | chamber |
| 12 | component |
| 14 | component |
| 16 | pressure compensating device |
| 18 | pressure compensating device |
| 20 | filter element |
| 22 | holding component |
| 24 | holding element |
| 26 | bearing |
| 28 | lubricant seal |
| 30 | lubricant seal |
| 32 | bearing seat |
| 34 | bearing seat |
| 36 | pressure compensating duct |
| 38 | pressure compensating duct |
| 40 | annular groove |
| 42 | housing |
| 44 | motor chamber |
| 46 | drive motor |
| 48 | tool holder |
| 50 | drill |
| 52 | handle |
| 54 | handle |
| 56 | intermediate wall |
| 58 | pinion |
| 60 | outer ring |
| 62 | inner ring |
| 64 | bearing gap |
| 66 | ring |

Claims

1. A machine tool, more particularly a hand-guided hammer drill, with a chamber (10) with lubricant, in which at least one rotatably driven component (12, 14) is arranged, and with a pressure compensating device (16, 18) of the chamber (10), which comprises at least one rotatably driven centrifugal component, characterised in that the centrifugal component is formed by a filter element (20).

2. A machine tool according to claim 1, characterised in that the rotatably driven component (12, 14) is formed by a motor shaft.

3. A machine tool according to claim 1 or 2, characterised in that the filter element (20) is formed by an annular component.

4. A machine tool according to claim 3, characterised in that the annular filter element (20) is non-rotatably held on the rotatably driven component (12, 14) by an annular holding component (22) with individual holding elements (24) extending in an axial direction.

5. A machine tool according to one of the preceding claims, characterised in that the filter element (20) is formed by felt.

6. A machine tool according to one of the preceding claims, characterised in that the filter element (20) is arranged directly in front of a bearing (26) of the rotatably driven component (12, 14) in the ventilating direction of the chamber (10).

7. A machine tool according to one of the preceding claims, characterised in that a bearing (26) of the rotatably driven component (12, 14) forms at least part of a lubricant seal (28, 30) of the pressure compensating device (16, 18), by means of which a pressure in the chamber (10) can be compensated.

8. A machine tool according to claim 7, characterised in that the lubricant seal is arranged as a gap seal between the bearing and a bearing seat.

9. A machine tool according to claim 7 or 8, characterised in that a pressure compensating duct (36, 38) is formed in a bearing surface of the bearing and/or in a bearing surface of a bearing seat (32, 34).

10. A machine tool according to claim 9, characterised in that the pressure compensating duct (38) is at least partially formed by a thread-shaped recess.

11. A machine tool according to claim 10, characterised in that the pressure compensating duct (38) opens out into at least one annular groove (40).

12. A machine tool substantially as herein described with reference to the accompanying drawings.

**Application No:** GB 0122047.4 **Examiner:** Gareth Prothero
**Claims searched:** 1 to 12 **Date of search:** 6 February 2002

# Patents Act 1977
# Search Report under Section 17

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T): B3C; B4C

Int Cl (Ed.7): B23B; B25D

Other: Online: WPI, EPODOC, JAPIO

**Documents considered to be relevant:**

| Category | Identity of document and relevant passage | | Relevant to claims |
|---|---|---|---|
| A | EP 0589337 A1 | (BOSCH) 30.03.1994 (See figs and WPI Abstract Accession No. 1994-103008/44). | |
| A | US 4403679 A | (SNIDER) See especially felt element 48, and col 3, lines 43 to 45. | |
| A | US 3719254 A | (SNIDER) See whole document. | |

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| X | Document indicating lack of novelty or inventive step | A | Document indicating technological background and/or state of the art. |
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